Exploring Meteorite Mysteries

Lesson 9 — Meteorite Sleuths!

"What are they?"

Objectives

Students will:

- simulate techniques used by scientists.
- develop skills in acquiring data through the senses.
- observe, examine, record, and sketch data.
- use magnifying glasses, microscopes, and balances.
- experience conceptual application.

Background

See background information on Student Sheet, Station 4, page 9.7.

Lesson Information

Scientists use a variety of methods to classify materials and objects. Specific technologies and techniques are used in the classification of meteorites. The Meteorite Sample Disk (or photographs if the Meteorite Sample Disk is not available) is the focal point for these activities presented in a laboratory format. The laboratory activity is broken into four sections that simulate meteorite identification methods. A rotation lab is suggested with the Meteorite Sample Disk displayed at a central location for periodic comparisons. Teams of students will work at numbered stations, taking lab notes in appropriate sections on a prepared laboratory worksheet. Rotations will be ordered numerically; however, no specific order is necessary in completing the lab. Since all portions of the lab are broken down according to stations, teachers may prepare for and include only those portions desired.

***Note**: Station numbers should be clearly identified to facilitate orderly rotations. Additional duplicate stations may be set up to allow for more than 4 groups per class.*

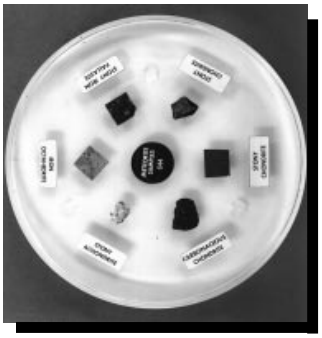
Upon completion of all rotations a "wrap-up" session in which lab results are reviewed and discussed **in order,** will clarify student understanding. The students have made observations from general macroscopic inspections to microscopic details — like the game "20 Questions" in which someone is asked to identify an unknown life form via 20 "yes/no" questions. The winner invariably goes from general to specific questions.

About This Lesson

The activities in this lesson focus on observation and examination skills. A Meteorite Sample Disk (or photos) will be at the center of four laboratory stations. Students will use several degrees of magnification to research meteorites in the Meteorite Sample Disk and other materials. Discussing the sequence will help them understand how scientists approach meteorite research and classification.

Vocabulary

texture, chondrite, achondrite, stony-iron, iron, mass, density, volume, specimen, classification, hypothesis, cross section, carbonaceous chondrite



Materials

- ❑ Meteorite Sample Disk or photographs
- ❑ magnifier
- ❑ binocular reflected light microscope *(optional)*
- ❑ Student Sheet *(pgs. 9.5-9.8)*

Lesson 9 — Meteorite Sleuths!

Meteorite Sample Disk Display

Procedure

Advanced Preparation

1. Gather and assemble materials.
2. Review lesson information and Station 4 background.
3. Set up Meteorite Sample Disk or photos in central station.

Classroom Procedure

1. Divide class into 4 or more groups.
2. Distribute Student Sheets.

Station 1: Initial Inspection

About This Station

Students visually examine a rock specimen and record observations of color, texture, and shape. Measurements are taken and a sketch of the rock is made. The students proceed to the Meteorite Sample Disk display and record colors of each meteorite.

Materials for Station 1

- ❑ fist-sized rock
- ❑ graph paper *(2 cm x 2 cm blocks)*
- ❑ metric ruler
- ❑ pencil, and map pencils or crayons
- ❑ Student Sheet *(pg. 9.5)*

Objectives

Students will:

- develop skills in acquiring data through the senses.
- measure, record, and sketch rock samples.

Procedure

Advanced Preparation

1. Place graph paper, rock, and ruler on lab table.

Classroom Procedure

1. Visually examine rock specimen.
2. Record observations related to color, texture, and shape of rock.
3. Measure rock and record measurements on Student Sheet.
4. Sketch rock to scale on grid provided.
5. Proceed to Meteorite Sample Disk display and record colors of each meteorite.

Station 2: How Dense Is Dense?

Procedure

Advanced Preparation

1. Place balance, gram masses (weights), container of marbles, and prepared index card (verifying equal volumes of all marbles) on lab table.
2. Consider steps 4 or 5 for upper grades or advanced students.

Classroom Procedure

1. Measure the mass of each type of marble.
2. Write a comparative statement using the words "mass" and "density" for each type of marble (density = mass/volume).
3. Proceed to Meteorite Sample Disk display and predict whether the iron or the achondrite has greater density.
4. **Optional:** Weigh equal volume (approximately) pieces of steel and basalt to compare to the iron and achondrite.
5. **Optional:** Look up the specific gravity of iron and the common rock forming minerals feldspar, and pyroxene found in achondrites. Use this information to help determine whether the iron or achondrite is more dense.

About This Station

Students will determine the mass of several marbles and hypothesize whether the iron or the achondrite has greater density.

Materials for Station 2

- ❑ beam balance
- ❑ metric masses *(2 small paper clips = 1 gm)*
- ❑ marbles and/or other objects of equal volume but different densities
- ❑ container for marbles
- ❑ index card showing diameters of the marbles to verify equal volumes of all marbles
- ❑ Student Sheet *(pg. 9.6)*

Station 3: Observation with Magnification

Procedure

Advanced Preparation

1. Place printed picture(s) and magnifiers on lab table.

Classroom Procedure

1. Examine picture(s) with the unaided eye.
2. Examine picture(s) with a magnifier.
3. Record your observations.
4. Proceed to Meteorite Sample Disk display and examine the stony-iron and the chondrite A with the unaided eye and a magnifier.
5. Record your observations on Student Sheet.

About This Station

Students examine printed images and the Meteorite Sample Disk with and without magnification.

Materials for Station 3

- ❑ full-color printed picture(s) — newspaper, magazine
- ❑ magnifier
- ❑ Student Sheet *(pgs. 9.6-9.7)*

Station 4: Journey to the Center of the Fruit

About This Station
Students experience the progression from general to more specific observations.

Materials for Station 4
- ❑ two of the same type of easy-to-slice fresh fruits that are optically interesting *(example: kiwis,* apples, oranges, tomatoes, etc.)*
- ❑ sharp knife
- ❑ cutting board
- ❑ magnifier
- ❑ binocular microscope
- ❑ clean slides and cover slips
- ❑ paper towels
- ❑ 3 index cards labeled "1," "2," and "3"
- ❑ Student Sheet *(pgs. 9.7-9.8)*

** Kiwi fruit is similar to most meteorites in that its outer surface is so different from the interior. The flesh of an apple is similar to most meteorites in that, under magnification (even with just a hand lens), the appearance is vastly different from that seen with the naked eye. The outer perimeter of the peel of an orange looks similar to fusion crust when under the microscope. The flesh of a tomato appears to have chondrules when magnified.*

Objective
Students will:

- experience conceptual application.

Procedure

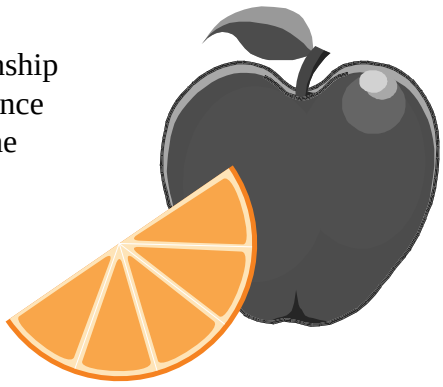
Advanced Preparation

1. Cut one piece of fruit into halves.
2. Cut one medium slice from one half so that a good cross section is revealed.
3. Cut one very thin cross section slice from the remaining half and place on slide on microscope stage.
4. Adjust microscope for viewing. Make thinner slice if necessary for microscopic viewing.
5. Place fruits and equipment on the lab table in the following order:
   - whole fruit (labeled: #1 whole fruit),
   - thick slice from half of fruit (labeled: #2 cross section) with magnifier,
   - thin slice mounted on microscope (labeled: #3 thin section).
6. Remaining fruit will not be needed in this lab exercise.

Note: *If microscope is not available, a magnifying glass or hand lens is adequate for meeting the lab objectives.*

Classroom Procedure

1. Read background information on Student Sheet (pg. 9.7).
2. Observe all samples in order and record observations, **not** what you already know.
3. View the meteorites using a microscope if available.
4. Write a short paragraph that describes the relationship between your lab experience and the information on the Student Sheet.



Student Sheet: Stations 1-4

Station 1: Initial Inspection

Procedure

1. Visually examine rock specimen.
2. Beside the grid below, record observations related to color, texture, and shape of rock.
3. Measure rock and record measurements beside the grid below.
4. Sketch rock to scale on grid provided below (be sure to add scale).
5. Proceed to Meteorite Sample Disk display and record colors of each meteorite.

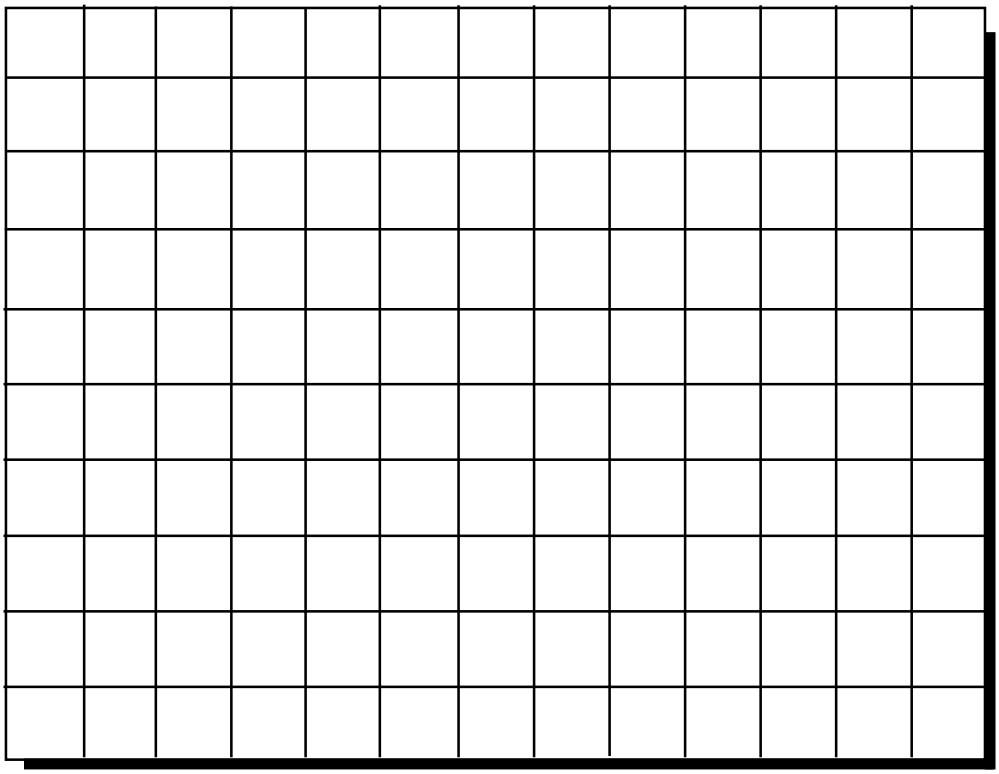
Rock Sketch

Color:

Texture:

Shape:

Dimensions:



Meteorite Colors:

Station 2: How Dense Is Dense?

Procedure

1. Measure the mass of each type of marble.
   Mass of first marble type: ___ gm Mass of second marble type: ___ gm

2. Write a comparative statement using the words "mass" and "density" for each type of marble (density = mass/volume).

3. Proceed to Meteorite Sample Disk display and predict whether the iron or the achondrite has greater density. (Circle one) Iron Achondrite

4. What data would be necessary to support your prediction?

5. How do density and mass relate to identification of meteorites?

Station 3: Observation with Magnification

Procedure

1. Examine the picture both with the unaided eye and the magnifier. Describe or sketch your observations. Complete the sentences below using details of your observation.

   With the unaided eye the picture is...

   Viewed through the magnifier the picture is...

2. Proceed to Meteorite Sample Disk display. Using your unaided eye and the magnifier repeat observations for the meteorites listed below.

   Stony-iron is...

   Chondrite A is...

3. Why would a scientist make observations with and without magnification?

4. Which observation gives more usable data for meteorite investigations? Explain your reasoning.

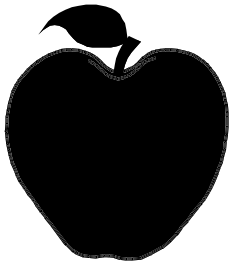
Station 4: Journey to the Center of the Fruit

Background

Scientists studying meteorites use various types of observations. They make qualitative (color, shape, texture, etc.) and quantitative (mass, volume, linear measurement, etc.) observations, recording all data carefully. They use special tools to chip off parts and saw through meteorites to make closer visual observations. They write careful descriptions throughout their investigations.

Very thin sections are cut and mounted on slides for microscopic examination. Higher powered microscopes, such as an electron microscope, and other advanced technology give an even clearer picture of the minerals and other materials that make up the meteorite.

Meteorites are classified based on the types, amounts and textures of minerals they contain. The primary classification into stony, iron and stony-iron is based on the amount of metal. Stony meteorites are divided into chondrites, which contain round inclusions called chondrules, and achondrites, which do not contain chondrules. Previously classified meteorites are frequently referred to with continual comparisons being made.



As new information about a meteorite is obtained, scientists may change their initial classification. The progression from general to more specific observations helps scientists to narrow the possibilities in characterizing meteorites. The study of these rocks from outer space helps to answer questions about how our solar system formed and the relationships of planetary bodies to each other.

Procedure

1. Observe all samples in order and record observations. Do **not** record just what you already know.

   #1. Whole Fruit

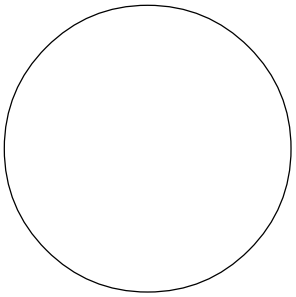
   #2. Fruit Cross Section

   #3. Fruit Thin Section

2. If a microscope is available at the Meteorite Sample Disk display, view all the meteorites and list one where you see much more detail in the microscope than you did with your unaided eye. Sketch and describe the meteorite's detail you see in the microscope.

   meteorite sample name

   _____



3. Write a short paragraph that describes the relationship between your lab experience and the background information.

4. What questions must be answered first in a scientific investigation?

5. What is the progression scientists follow in examining a specimen?